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Species Composition and Angler Use of Fish in Gleniffer Lake (Dickson Dam Reservoir)

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TABLE OF CONTENTS

		PAGE
	SUMMARY	iii
	PROJECT TEAM	iv
	ACKNOWLEDGEMENTS	iv
1.	INTRODUCTION	1
	1.1 Background	1
	1.2 Purpose of Study	1
2.	STUDY AREA	3
	2.1 Red Deer River	3
	2.2 History of Dam and Reservoir Facility	3
	2.3 History of Fish Plantings	4
3.	MATERIALS AND METHODS	8
	3.1 Species Composition	8
	3.1.1 Beach Seine	8
	3.1.2 Gill Net	9
	3.2 Creel Census	12
4.	RESULTS	15
	4.1 Physical Conditions	15
	4.2 Beach Seine	15
	4.3 Gill Net	20
	4.4 Creel Census	26
5.	DISCUSSION	31
	REFERENCES	34
	APPENDICES	36
	Appendix I	36
	Appendix II	37
	Appendix III	38

SUMMARY

Fish were collected by beach seine and gill net from a newly-formed reservoir (Gleniffer Lake, Alberta) over a five-year period (1983-1987). A creel census was also conducted for three years (1985-1987). From these collections, it was observed that:

i) the most frequently captured species in the gill nets were white sucker (Catostomus commersoni), longnose sucker (Catostomus catostomus), northern pike (Esox lucius), and burbot (Lota lota). Although rainbow trout (Oncorhynchus mykiss) were planted in large numbers in the reservoir, they made up only a small part of the catch,

ii) the catch per unit effort (CUE) using gill nets was low, ranging from 1 to 4.7 fish (all species) per 1000 m net per h,

iii) planted rainbow trout and brown trout (Salmo trutta) apparently failed to spawn in the reservoir,

iv) the mountain whitefish (Prosopium williamsoni) population declined dramatically after impoundment,

v) the populations of northern pike, white sucker, longnose sucker and burbot apparently expanded immediately after impoundment, and later decreased in numbers,

vi) the most frequently captured fish by anglers were rainbow trout, brown trout and northern pike,

vii) the CUE for angling was extremely low; depending on year, 11-45 h were required to angle one fish.

It was concluded that Gleniffer Lake provided poor habitat for all the major species of sport fish during the period 1983-1987.

PROJECT TEAM

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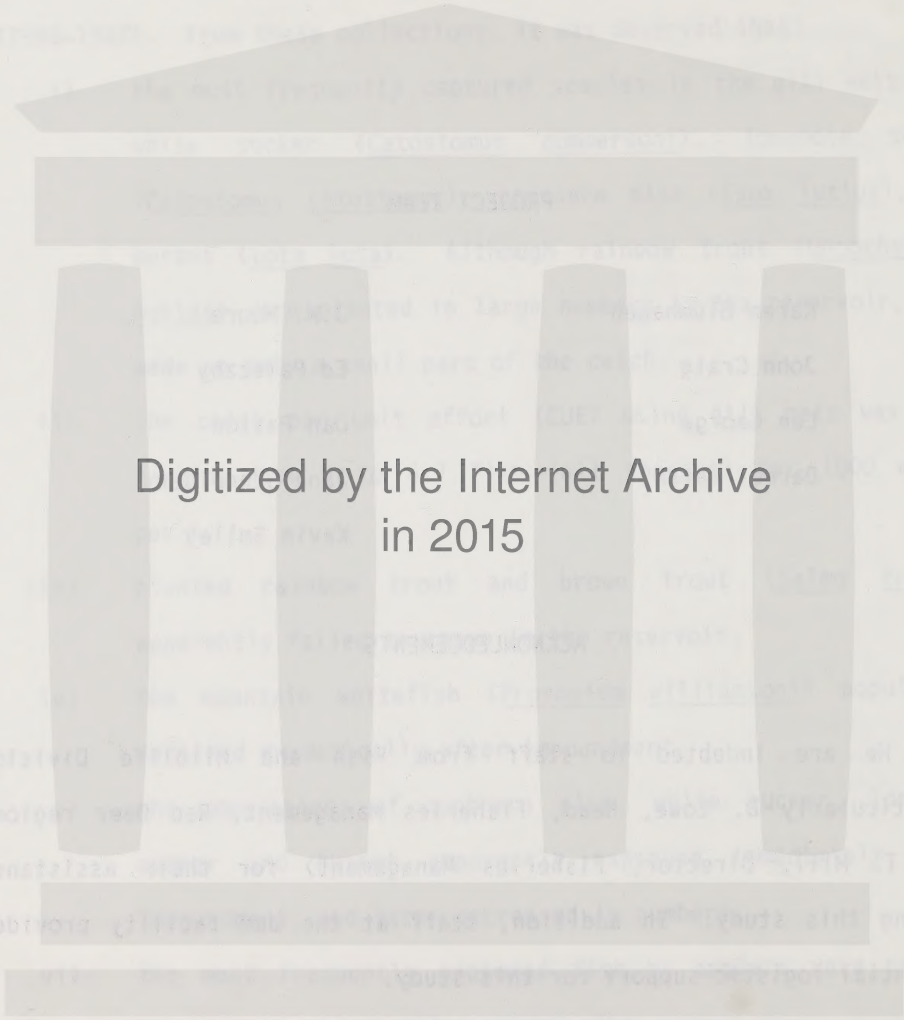

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1. INTRODUCTION

1.1 Background

Gleniffer Lake, located on the Red Deer River west of the City of Red Deer, was formed with the completion of the Dickson Dam in 1983 (Figure 1). The reservoir has an area of 1734 ha at full storage and measures approximately 11 km in length and 2 km in width. The facility provides two primary benefits: i) an assured water supply for downstream communities, and ii) improved water quality downstream.

During the spring and summer, runoff water is captured in the reservoir. Enough water is released during the winter to ensure a minimum flow of at least 16 m^3s^{-1}. This rate of flow meets the present needs of downstream industries and communities including the Cities of Red Deer and Drumheller, and allows for future growth.

1.2 Purpose of Study

Because of its size and accessibility, the reservoir holds the potential to be a significant sport fishing facility. The purpose of this study was, therefore, to document the species composition of fish populations in the reservoir in 1983, and to monitor changes in the populations over a five-year period. Such information will influence the future fisheries management strategy employed to develop and maintain a recreational fishery on the reservoir. This study also includes the results of a three-year creel census, conducted to determine the use of the fisheries resource by anglers.

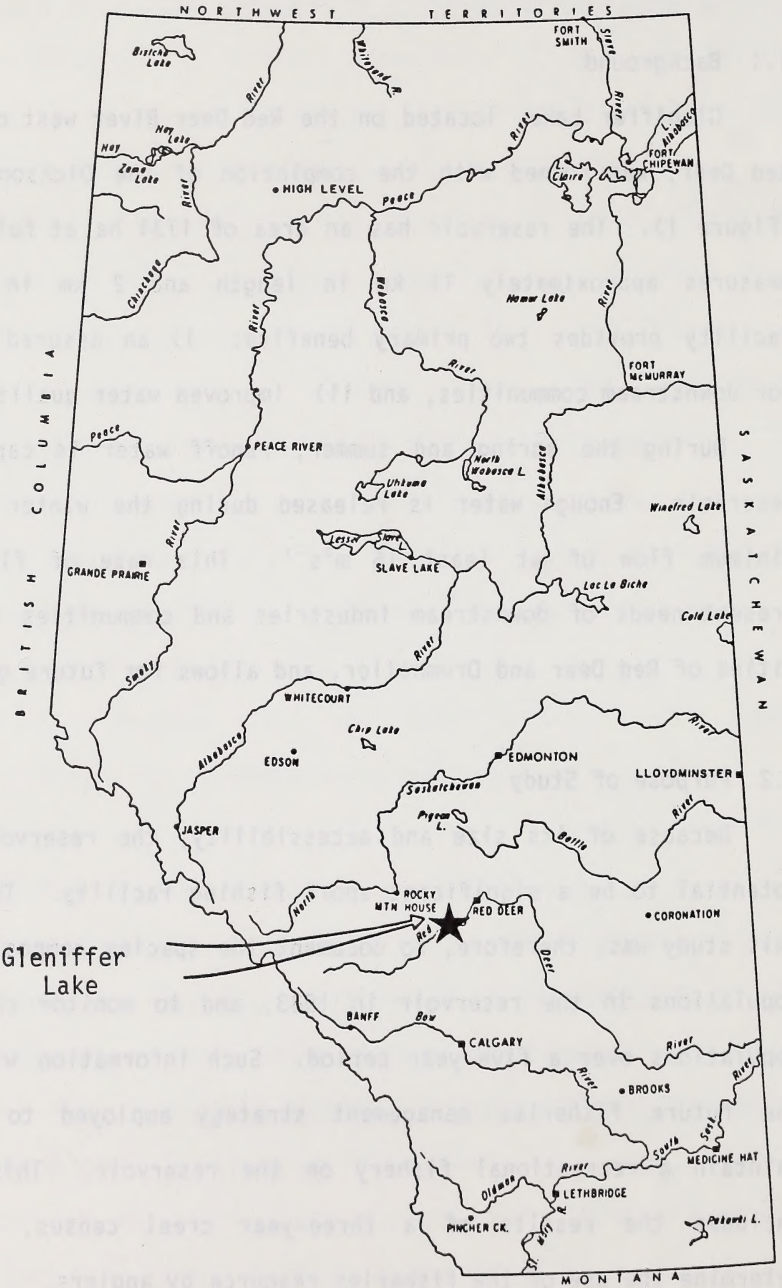

Figure 1. Location of Gleniffer Lake.

2. STUDY AREA

2.1 Red Deer River

The Red Deer River originates in Banff National Park at an elevation of approximately 1830 m above sea level. The river flows 185 km through the Rocky Mountains to Gleniffer Lake which is at an elevation of 948 m above sea level at Full Service Level (FSL). The drainage area to this point is 5520 km^2. The river continues a further 571 km eastward across the parkland and prairies where it joins the South Saskatchewan River near Alberta's border with Saskatchewan.

2.2 History of Dam and Reservoir Facility

Technical studies began in 1971 and, after 5 years of investigation and a series of public hearings, a decision was made to build the dam. Clearing of the site and construction of access roads began in February 1980. By the spring of 1983, the dam was completed and the reservoir began filling.

The service spillway can handle any major flood occurring over a 10,000 year period. In the unlikely event of a larger flood, an emergency spillway could be used to divert excess flow. A flood forecasting system using remote rainfall gauges and satellite communications gives early warning to operators about oncoming floods. The diversion tunnels are equipped for installation of hydroelectric power facilities, if needed. A summary of information on the dam and reservoir is listed in Table 1.

A small pond, subsequently referred to as the Trout Pond, is located on the northeast part of the reservoir facility and is completely separated from the main lake (Figure 2). The pond, measuring approximately 1 km in diameter with a maximum depth of approximately 7.5 m, was formed with the construction of a dyke across an existing oxbow. The pond is used primarily for sport fishing for rainbow trout.

Another pond, the Dam Pond, is located immediately downstream of the service spillway (Figure 2). The pond, with a maximum depth of 5 m, is stocked with rainbow trout and used solely by handicapped anglers.

2.3 History of Fish Plantings

Rainbow trout (Oncorhynchus mykiss) and cutthroat trout (Salmo clarki) were first planted in Gleniffer Lake in 1983 (Table 2). The introductions of rainbow trout continued through to 1987, but no further cutthroat trout were planted beyond 1983. Brown trout (Salmo trutta) were introduced to the reservoir only during 1984 (Table 2). Total plantings for all species exceeded one million fish.

Rainbow trout were also introduced into the Trout Pond. More than 200,000 fish were planted between 1985 and 1987 (Table 2).

Table 1. Summary of information on Dickson Dam, Gleniffer Lake and surrounding area.

DAM	
Crest Length	650 m
Height	40 m
Volume of Fill	3,600,000 m^3
Crest Elevation	952 m
TUNNELS (2)	
Length	525 m
Diameter	5.5 m
Design Discharge	38 $m^3 s^{-1}$
SPILLWAY	
Weir Elevation	940.5 m
Weir Length	60 m
Structure Length	235 m
Vertical Gates (5)	8.6 x 9.6 m
Design Discharge	2,600 $m^3 s^{-1}$
EMERGENCY SPILLWAY	
Channel Width	130 m
Design Discharge	2,800 $m^3 s^{-1}$
RESERVOIR	
Flooded Area (Full Storage Level)	1,734 ha
Usable Storage	203 million m^3
Reservoir Length	11 km
Reservoir Width	2 km
Full Storage Level	948 m elevation
Annual Flush Rate	5.5 x
Proportion of incoming sediment retained	88 %
Annual amount of sediment retained	290,000 m^3
Life Expectancy	500 yrs
DYKES	
Length (North Side)	3.0 km
Length (South Side)	3.7 km
DRAINAGE BASIN	
Area	5,520 km^2
Mean Annual Run-off	32 m^3

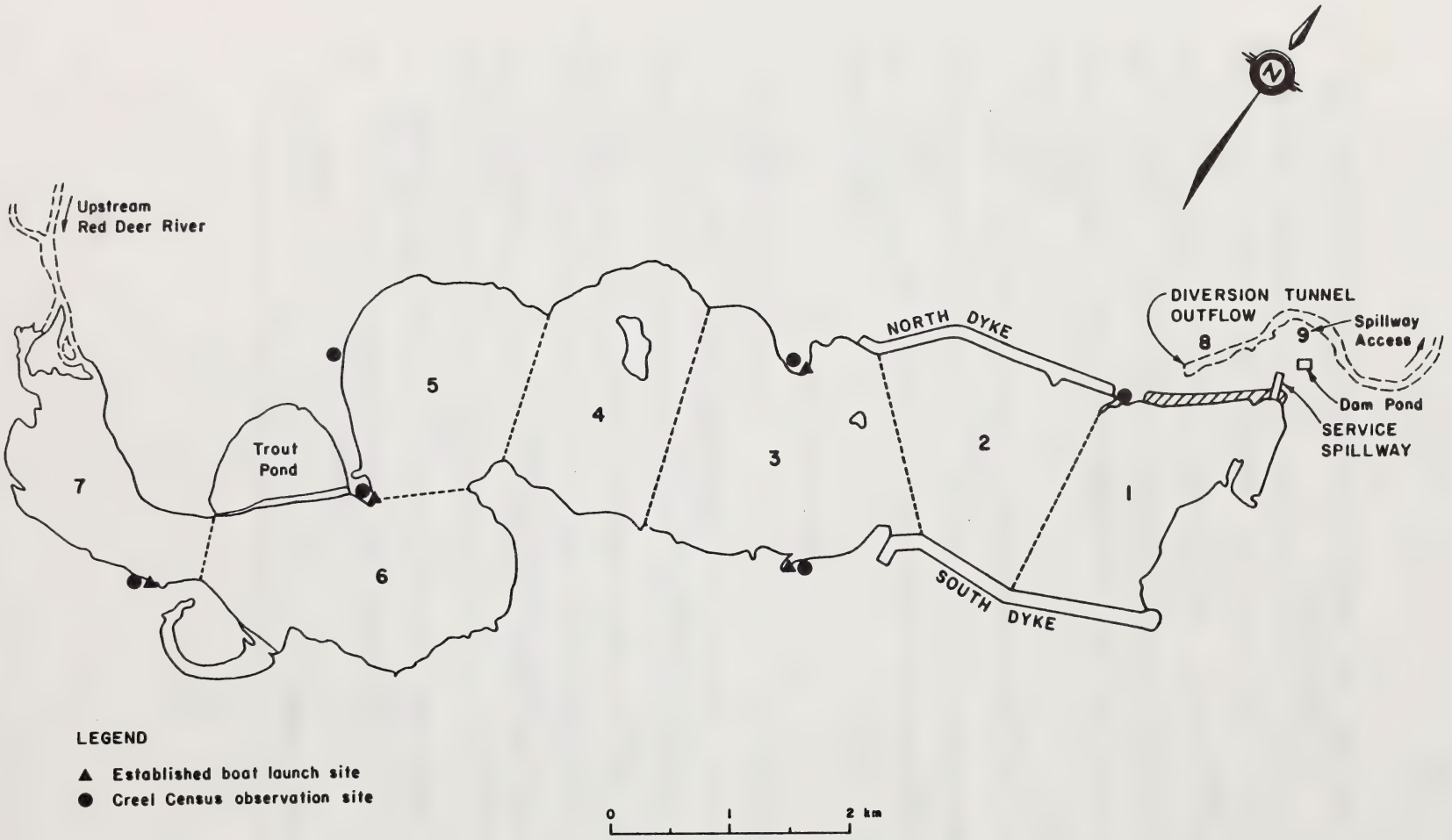

Figure 2. Location of the Trout Pond, Dam Pond and downstream facilities. Numbers refer to zones used in creel census.

Table 2. Summary of fish plantings carried out at Gleniffer Lake and the trout pond.

Year	Species	Month(s) Planted	Number Planted	Length (cm)
		Gleniffer Lake		
1983	Rainbow Trout	Sept.	61,557	4.8 - 20
1983	Cutthroat Trout	Sept.	135,635	~ 5.5
1984	Rainbow Trout	June, Aug., Sept.	152,600	6.4 - >20
1984	Brown Trout	Aug., Sept.	67,100	5.2 - >20
1985	Rainbow Trout	May, June, Aug.	498,500	5.6 - 12
1986	Rainbow Trout	Aug.	180,000	>15
1986	Rainbow Trout	Sept., Oct.	375	>20
1987	Rainbow Trout	Aug.	242	>20
Totals 83-87	Rainbow Trout		893,274	4.8 - >20
	Cutthroat Trout		135,635	5.5
	Brown Trout		67,100	5.2 - >20
GRAND TOTAL	Trout (all species)		1,096,009	4.8 - >20
		Trout Pond		
1985	Rainbow Trout	July	101,000	9.0 - 11.0
1986	Rainbow Trout	June	50,000	11.3 - 12.2
1986	Rainbow Trout	Jan., Oct., Nov.	965	>20.0
1987	Rainbow Trout	July, Aug.	52,700	10.7 - 13.3
Total	Rainbow Trout		204,665	9.0 ->20.0

SOURCE: Fish Planting List (1983-1987).

3. MATERIALS AND METHODS

3.1 Species Composition

The species composition of the population was determined through a series of collections using beach seines and gill nets. The scientific and common names of all fish collected in this study are given in Appendix I. Collections were made over a number of years at several sites throughout the reservoir (Table 3).

Table 3. Schedule for beach seine, gill net and creel census.

	1983	1984	1985	1986	1987
Beach Seine	-	*	*	*	*
Gill Net	+	*	*	*	*
Creel Census	-	-	*	*	*

*Collections completed by AEC staff
+Collections completed by Fish and Wildlife Division.
-No collections.

3.1.1. Beach Seine

The seine net was 18 m in length, 1.8 m in depth with a center bag of 1.8 m x 1.8 m x 1.8 m. The mesh was 6.4 mm delta white nylon except for the bag which had a mesh of 3.2 mm.

Four sites in each of three basins (west, central and east) were selected for a total of 12 sites (Figure 3, Table 4). These sites were sampled once a month from May-September during the 1985, 1986 and 1987 field seasons.

After capture, fish were given a lethal dose of the anaesthetic MS222 and then preserved in 10% formalin for later identification and enumeration. If a large number of small fish were caught, a random subsample was taken and weighed. The remainder of the catch was also weighed, enabling an estimate to be made of the total catch.

At each sampling site, the length of set, depth of set, type of bottom material, temperature, pH and conductivity were recorded using a Hydrolab (Surveyor II) unit. Secchi disk readings were taken in each of the three basins.

A thermograph (Ryan Model J-180), designed for continuous temperature recording, was submerged 1 metre below the water surface at the east end of the reservoir (Site B). Data were collected from June 24 - October 1, 1986 and from May 28 - October 9, 1987.

3.1.2 Gill Net

Multi-panel gill nets, measuring 50 m in length, were used in all collections. The nets, 1.8 m deep, were made of green or colourless monofilament nylon. Two nets were usually tied together, yielding a total length of 100 m. Mesh sizes were 1.9, 2.5, 3.8, 5.1, 6.4, 7.6, 8.9, 10.2, 11.4 and 12.7 cm.

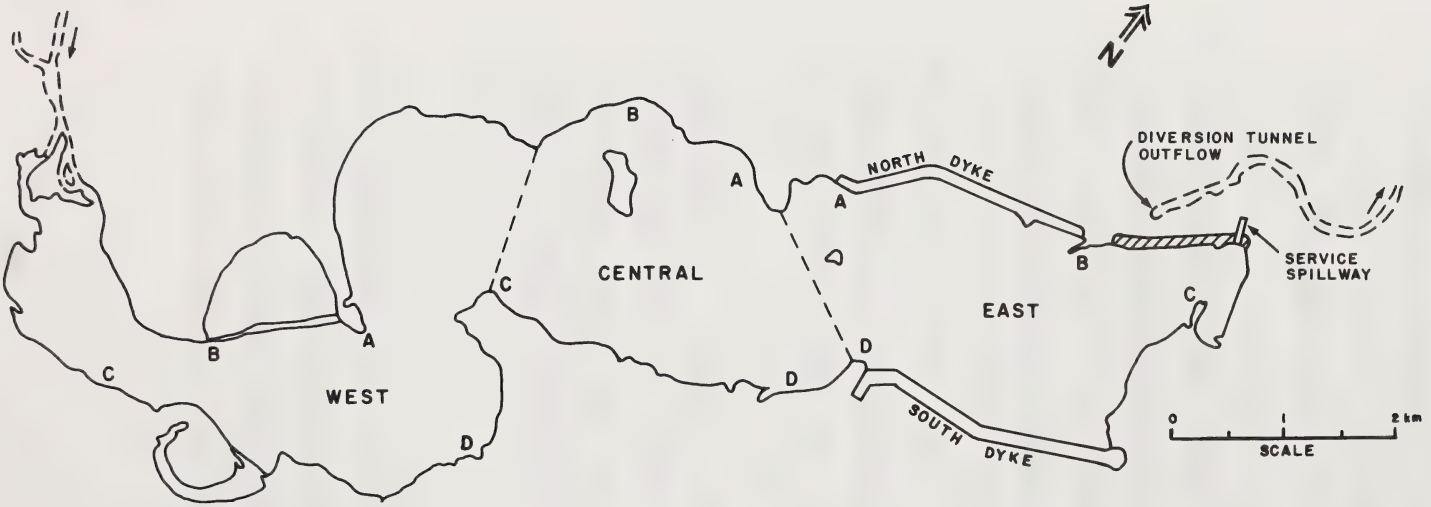

Figure 3. Beach seine sampling sites.

Figure 4. Gill net sampling sites. Deep set (greater than 10 m); shallow set (less than 10 m).

Table 4. Description of beach seine sites.

Location	Maximum Depth (m)	Description of Bottom Texture
East A	2	Cobble, sand
East B	2	Soft sand/clay
East C	2	Gravel, soft sand/clay
East D	7.5	Cobble
Central A	2.5	Sand/gravel
Central B	3	Sand
Central C	2	Soft sand/clay
Central D	4.5	Cobble, some sand
West A	4	Sand
West B	2.5	Sand
West C	3	Cobble, sand
West D	4	Sand

There were two sampling sites in each of the three basins (Figure 4). One site was situated in shallow (<10 m) water and the other in deep (>10 m) water. Selection of an actual site was based on its suitability for gill netting, specifically minimum slope and minimum debris content.

Each net was set in the morning and left for 24 h. The temperature, pH, conductivity, dissolved oxygen content, depth of water and secchi disk transparency were recorded. The fish were taken to a field laboratory where the species, fork length, and wet weight of each fish were determined. The catch per unit effort (CUE) was expressed as the total number of fish caught per hour. Because the length of net used varied with each year, the CUE was then adjusted to a standard length of net (1000 m).

3.2 Creel Census

The creel census was conducted over a three year period (1985-87) between the Victoria Day holiday in May and the Labour Day holiday in September. The census was conducted on the reservoir, the Trout Pond, the Dam Pond, the diversion tunnel outflow, and the service spillway (Figure 2). During 1985, one creel attendant implemented the procedures in Table 5, whereas two attendants were used in 1986. Only one part-time creel attendant was employed in 1987 due to budgetary restraints.

Information on the length of the creel census season, total number of shifts, number of interviews, total number of angler-reported fishing hours and number of observed fishermen is given in Table 6.

During 1986 and 1987, a comparison was made between the number of angler-reported fishing hours (ARH) and the actual number of hours spent fishing. The actual number of hours was determined by the creel attendant (CRH) who watched anglers from the time they began fishing to the completion of angling. In 1986, 103 such observations were conducted. Of these, the ARH exceeded the CRH in 44 cases; in another 38 cases, the ARH was less than the CRH, whereas the remaining cases differed by 0.1 h. In 1987, 82 observations were conducted. Of these, the ARH exceeded the CRH in 35 cases; in 28 cases the ARH was less than the CRH and, in the remaining 19 cases, the ARH and CRH were similar. Overall, the ARH exceeded the CRH by approximately 0.3 h/interview. The creel census data reported later in this report are based on ARH. No adjustments were made based on the CRH because

Table 5. Creel census procedures used during 1985-1987 on Gleniffer Lake.

1985
i) The reservoir was surveyed from prominent access points for anglers in boats and on shore (Appendix II).
ii) Interviews were conducted in areas where angler density was greatest (Appendix III).
iii) Anglers using boats were interviewed at three public launch sites.
iv) One 8-h shift was completed per day. The shifts were rotated between the hours of 700 - 2300 h. The census was conducted on weekends, holidays and most week days.
v) All reported lengths and weights of fish were taken by the attendant.
1986
i) The reservoir was surveyed from prominent access points for anglers in boats and on shore.
ii) Interviews were conducted at a single boat launch where angler activity was greatest.
iii) Anglers using boats were interviewed after returning to the launch sites.
iv) Two 8-h shifts were completed per day between 700 and 2300 h. The creel census was conducted continuously during the summer.
v) All reported lengths and weights of fish were taken by the attendant.
1987
i) The census was conducted as in 1985 with the exception that interviews were conducted for 1 week per month.

Table 6a. Creel census data for Gleniffer Lake.

Creeling Season	1985 17 May-2 Sept.	1986 16 May-21 Sept.	1987 26 May-3 Sept.
Number of Shifts	69	147	37
Number of Interviews	783	713	116
Number of Angler-reported Fishing Hours	5671	5807	752
Number of Anglers Observed			
Anglers on Shore	587	318	96
Anglers in Boats	1195	1345	140

Table 6b. Creel census data for the Trout Pond, Dam Pond, diversion tunnel outflow, and service spillway.

Creeling Season	1985 26 May-2 Sept.	1986 16 May-21 Sept.	1987 26 May-3 Sept.
Number of Shifts	69	147	37
Number of Interviews	66	222	268
Number of Angler-reported Fishing Hours	439	1607	1230

i) such information was not available for 1985, and ii) the number of comparisons between ARH and CRH is small relative to the total number of interviews.

4. RESULTS

4.1 Physical Conditions

Full Service Level of the reservoir (948 m above sea level) was achieved during the summer of each year and maintained through most of the fall. Minimum water level has increased each year, exceeding 948 m during the winter of 1986/1987 but was as low as 933 m in 1984.

Surface water temperatures reached a maximum of >20°C during the summer of each year (Table 7). Based on the thermograph data, temperatures changed rapidly, as much as 4°C in one week. The water column was also thermally stratified (Figure 5). On 28 July, 1985 for example, surface water temperature was 22°C, falling to 16.9°C at 15 m and 7.7°C at 30 m. By September of that same year, however, the corresponding range in temperatures was 15.4 to 13.1°C.

Dissolved oxygen concentration at the surface generally exceeded 8 mg L^{-1} (Table 7), but declined with depth (Figure 5). Oxygen as low as 3.8 mg L^{-1} was recorded at 30 m. During the summer pH of the reservoir water ranged from 7.3 to 8.6 whereas conductivity was 252 to 419 µS cm^{-1} (Table 7). Secchi disk ranged from 0.25 to 2.9 m, and averaged 2.5 m.

4.2 Beach Seine

Almost all of the identified fish collected in the beach seines from 1984 to 1987 were juvenile suckers (Catostomidae), juvenile salmonids (Salmonidae), minnows (Cyprinidae), and trout-perch

Table 7. Summary of physical and chemical conditions in surface water of Gleniffer Lake (1985-1987).

	Range			
Month	Temperature °C	pH	Dissolved Oxygen (mg L^{-1})	Conductivity (µS cm^{-1})
June 85	14.1 - 16.3	7.5 - 7.7	8.1 - 10.1	285 - 332
July 85	18.6 - 20.4	7.3 - 7.6	7.7 - 8.4	329 - 337
Aug. 85	14.5 - 16.0	7.5 - 7.7	9.0 - 9.4	320 - 338
Sept. 85	6.7 - 10.9	7.5 - 7.8	9.2 - 11.6	300 - 317
Oct. 85	4.6 - 7.5	7.4 - 8.0	10.7 - 12.1	306 - 327
May 86	13.1 - 24.4	7.5 - 8.0	8.8 - 11.1	252 - 297
June 86	15.7 - 17.3	8.0 - 8.1	8.3 - 9.2	297 - 335
July 86	11.8 - 16.0	7.8 - 8.0	8.6 - 9.4	287 - 320
Aug. 86	15.8 - 18.6	7.5 - 7.8	7.8 - 9.0	316 - 367
Sept. 86	10.2 - 12.6	7.6 - 7.9	8.7 - 10.2	331 - 343
Oct. 86	7.0 - 10.2	7.9 - 8.1	9.6 - 10.9	317 - 349
May 87	12.8 - 15.8	8.2 - 8.4	9.4 - 10.3	377 - 419
June 87	17.5 - 20.3	8.2 - 8.6	8.3 - 8.9	318 - 378
July 87	19.7 - 22.8	8.2 - 8.4	7.9 - 9.0	316 - 363
Aug. 87	15.2 - 16.8	8.3 - 8.4	8.6 - 9.4	346 - 356
Sept. 87	14.4 - 16.3	8.2 - 8.3	8.6 - 9.4	321 - 368
Oct. 87	11.9 - 13.0	8.1 - 8.3	9.0 - 9.6	356 - 364

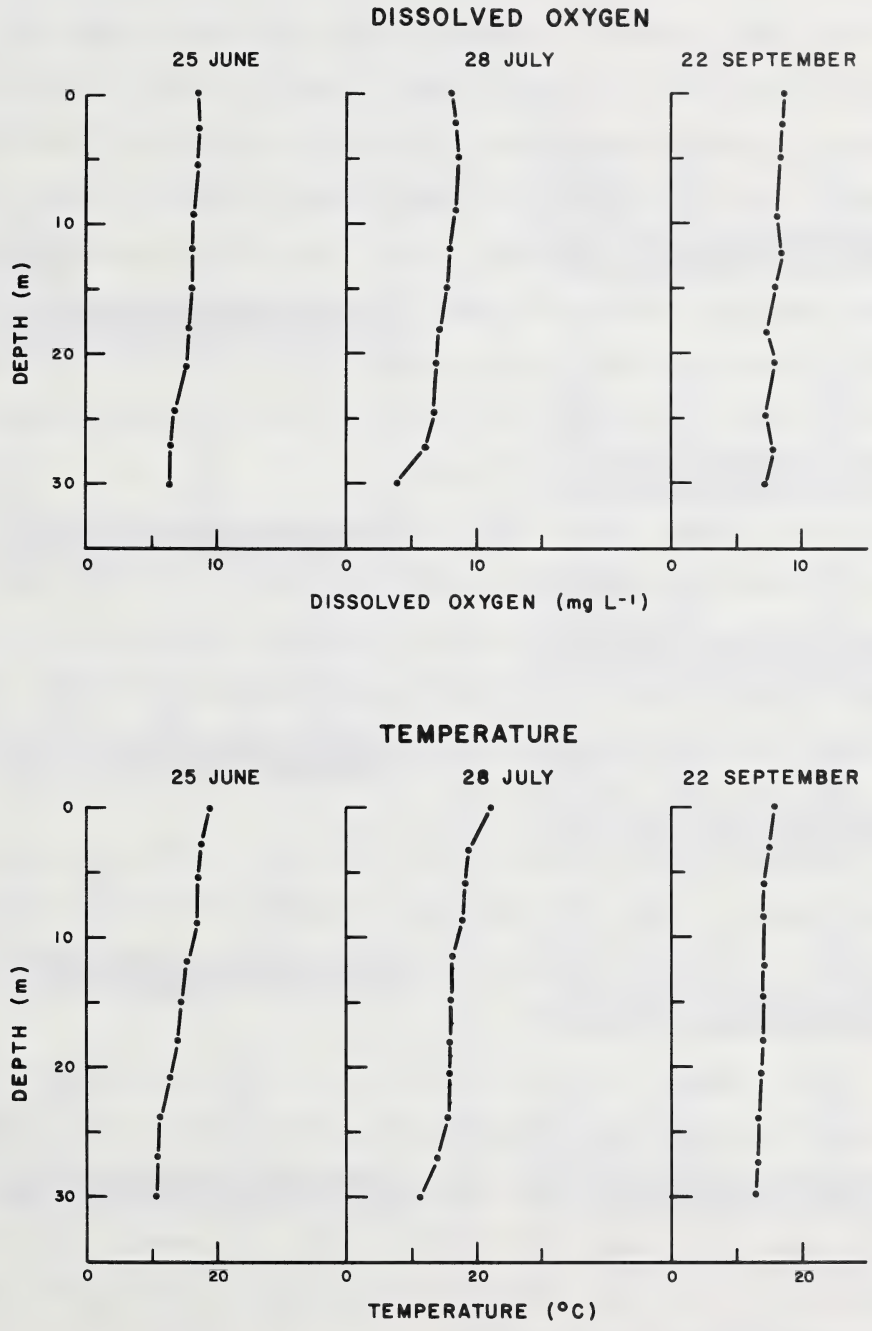

Figure 5. Example of stratification of dissolved oxygen and temperature during July (1985) in Gleniffer Lake.

(Percopsidae) (Figure 6). Because of the small size of the fish, and the deterioration of samples after longterm storage, most of the suckers, salmonids and minnows could not be positively identified. However, only two species of adult sucker (longnose sucker, white sucker) were taken in gill nets, so the juveniles were probably one of these species. Although the same applies to the salmonids for which only two species (brown trout, rainbow trout) were also observed in the gill nets, the species of minnow could not be inferred because no adults were present in the gill nets.

In all years except 1984, suckers were most abundant in the seines, comprising about 77% of the catch overall. The 1984 data are based solely on collections made in September, whereas in the other years, samples were taken from May to September. Minnows ranked second in overall abundance, accounting for 12% of the catch, followed by trout-perch.

A number of other species were also taken in the seines, but in low numbers. These included pike, juvenile whitefish (probably mountain whitefish), sculpins (Cottidae), burbot, and stickleback (Gasterosteidae).

In all years, a number of fish could not be assigned to any taxonomic category due to deterioration of the samples after longterm storage. The 1985 collection contains the greatest number of unknowns (1712 out of a total of 6537). Based on general morphology, essentially all of these fish (plus those from the other years) appear to be either suckers or minnows.

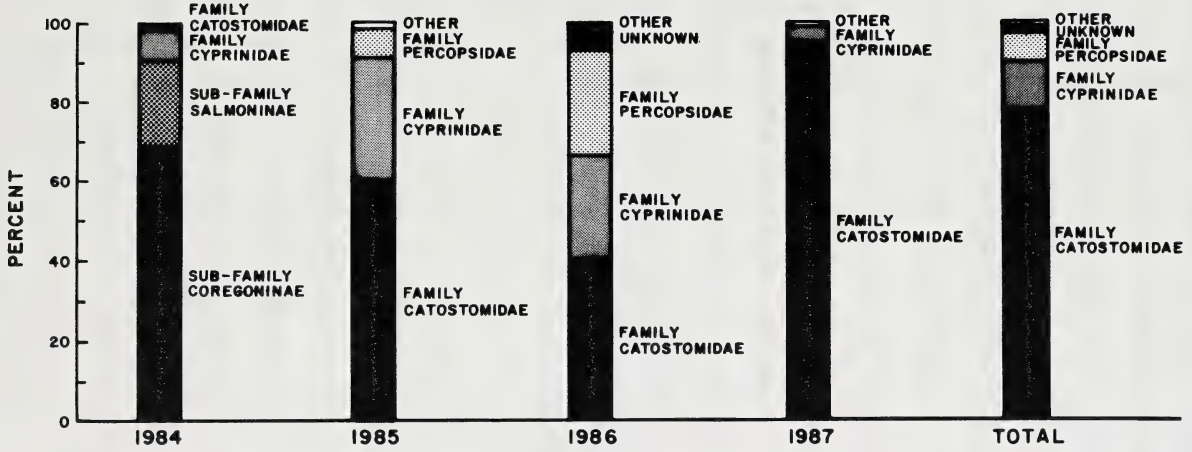

Figure 6. Beach seine catch summary, 1984-1987.

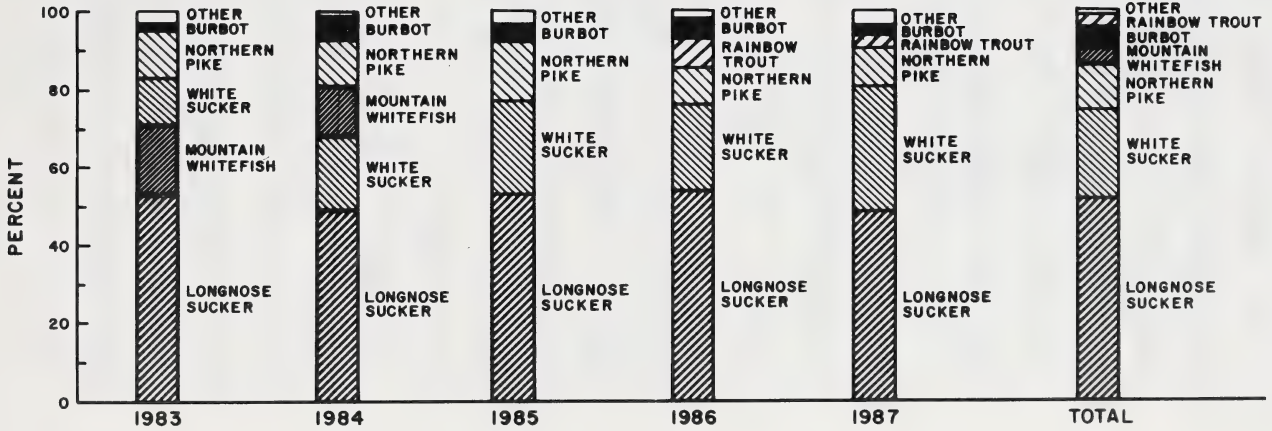

Figure 7. Gill net catch summary, 1983-1987.

The largest number of suckers was collected in the central basin of the reservoir. Only a few minnows were collected in the central basin; these species were more abundant in the eastern basin, as were trout-perch. These estimates of abundance depend to a large degree on the exact nature of the collection site and its suitability for maintaining small fish species. This means that the basin distribution data need to be interpreted with a great deal of caution.

The catch per unit effort (CUE) averaged almost 73 fish per minute over the course of the study (Table 8). The central basin yielded the greatest CUE, reflecting the presence of enormous numbers of young suckers. The CUE for all basins gradually increased through the course of the study, from 21 fish per minute in 1985 to 160 fish per minute in 1987. It is not known if this change was due to an actual increase in population numbers, or movement of fish into or out of the collection site at the time of sampling.

4.3 Gill Net

Longnose sucker and white sucker were the two most frequently captured species, together accounting for more than 70% of the catch during 1983-1987 inclusive (Figure 7, Table 9). Northern pike ranked third in frequency followed by burbot and mountain whitefish. Rainbow trout were netted in small numbers in each year whereas brown trout were caught only during 1983 and 1984.

Table 8. Beach seine catch per unit effort (1985 - 1987).

Date	Catch per Unit Effort (fish/minute)												
	West Basin				Central Basin				East Basin				Average
	A	B	C	D	A	B	C	D	A	B	C	D	
May 30, 31/85	5.2	0	1.6	41	1.2	0.2	0	4.6	2.0	2.7	0	5.2	5.3
June 19, 20/85	0	0.2	8.4	2.9	0	0.9	0	0	0.4	0	1.2	0.4	1.2
July 22, 23/85	1.0	554.7	48.0	0.6	6.6	2.7	-	0	0.4	4.5	5.7	0.2	56.8
August 29/85	293.3	0.2	0	0	0	0	-	17.8	0	111.1	1.6	0.4	38.6
September 25/85	0	0.2	0	6.5	1.8	1.3	-	0.2	0.4	1.5	2.0	0.2	1.3
Average 1985	59.9	111.1	11.6	10.4	1.9	0.9	0	4.5	0.7	24.0	2.1	1.3	20.6
May 28/86	7.5	28.4	3.8	17.3	5.3	11.8	0	4.0	5.2	0	42.0	2.5	10.6
June 25/86	1.0	1.0	0.2	1.0	0.3	0.2	0	0.2	5.2	42.2	649.8	0	58.4
July 30/86	2.0	17.2	1.0	7.6	2.2	1.7	-	12.0	2.9	1.6	50.2	1.0	9.0
August 20/86	636.0	212.3	0	-	0.3	51.6	-	0.8	2.0	1.6	0.9	0	90.5
September 17/86	0.8	1.2	2.7	-	0.8	0.4	-	1.2	0.7	0.4	0.8	0.4	0.9
Average 1986	129.5	522.0	1.5	8.6	1.8	13.1	0	3.6	3.2	9.1	148.7	0.8	33.9
May 28/87	0	1.0	0.3	0	0	0.4	0.4	0	11.6	-	0	0	0.3
June 25/87	-	115.9	8.4	1500.0	224.1	5000.0	-	185.0	262.0	26.8	25.6	1.9	734.9
July 28/87	-	215.7	22.5	17.7	1.5	6.0	-	0	1.4	334.7	-	1.5	75.1
August 25/87	-	0.6	0.5	1.2	0.4	0.4	-	5.0	0.6	23.8	21.9	2	5.6
September 23/87	-	26.4	0	1.0	0	0	-	0.8	0	-	0	0	3.1
Average 1987	0	71.9	6.3	304.0	45.2	1001.4	0.4	38.2	53.1	128.4	12.0	1.1	163.8
Total Average	86.1	78.3	6.5	122.9	16.3	338.5	0.1	15.4	19.0	42.4	57.2	1.1	72.8

-No samples taken

Table 9. Species composition (1983 to 1987) based on annual fall gill net collections.

Species	1983		1984		1985		1986		1987		TOTAL	
	N	%	N	%	N	%	N	%	N	%	N	%
Longnose Sucker	81	53.3	97	49.0	125	53.2	120	53.8	120	48.2	543	51.4
White Sucker	18	11.8	37	18.7	56	23.8	50	22.4	80	32.1	241	22.8
Northern Pike	18	11.8	23	11.6	35	14.9	20	9.0	25	10.0	121	11.4
Burbot	3	2.0	12	6.1	11	4.7	13	5.8	6	2.4	45	4.3
Mountain Whitefish	27	17.8	26	13.1	5	2.1	1	0.4	3	1.2	62	5.9
Rainbow Trout	2	1.3	1	0.5	1	0.4	16	7.2	8	3.2	28	2.6
Brown Trout	2	1.3	1	0.5	0		0		0		3	0.3
Brook Trout	0		0		1	0.4	0		0		3	0.3
Dolly Varden	1	0.7	0		0		0		0		1	0.1
Trout-Perch	0		0		0		2	0.9	1	0.4	3	0.3
Spottail Shiner	0		0		0		1	0.4	6	2.4	7	0.7
Spoonhead Sculpin	0		0		1	0.4	0		0		1	0.1
Chub - unidentified	0		1	0.5	0		0		0		1	0.1
TOTAL	152		198		235		223		249		1059	

N = number of fish caught
% = percent of total catch

The CUE for all species peaked in 1984 before falling to much lower levels for the remainder of the study (Table 10). Between 1985 and 1987 inclusive, the CUE for most species remained relatively constant, with the exception of white sucker, which appeared to increase in abundance. Mountain whitefish showed the greatest decline in CUE of any species in the reservoir, ranging from 0.30 - 0.61 in 1983/84 and 0.01 - 0.02 in 1985-87. The CUE for rainbow trout was always low (<0.11) as was the case with the other Salmonidae.

The average length and weight of rainbow trout caught in the gill nets increased substantially between 1983/84 and 1986 (Figure 8). This indicates that the planted fish grew in size as they aged. Although the size of fish remained constant between 1986 and 1987, the sample size for the 1987 catch was relatively small (N=8) and may not accurately reflect the length/weight characteristics of the population. Juvenile rainbow trout were not caught in the nets, indicating that the fish failed to spawn successfully in the reservoir.

Although mountain whitefish were caught in large numbers in 1983/84, the catch was much smaller in the remaining years of the study (Figure 8). Hence, it is not possible to assess any changes in the length/weight characteristics of the population between 1985 and 1987. The presence of relatively short (150 mm) fish in the nets throughout the study indicates that the population was able to spawn successfully in the reservoir or young fish are transported downstream into the reservoir.

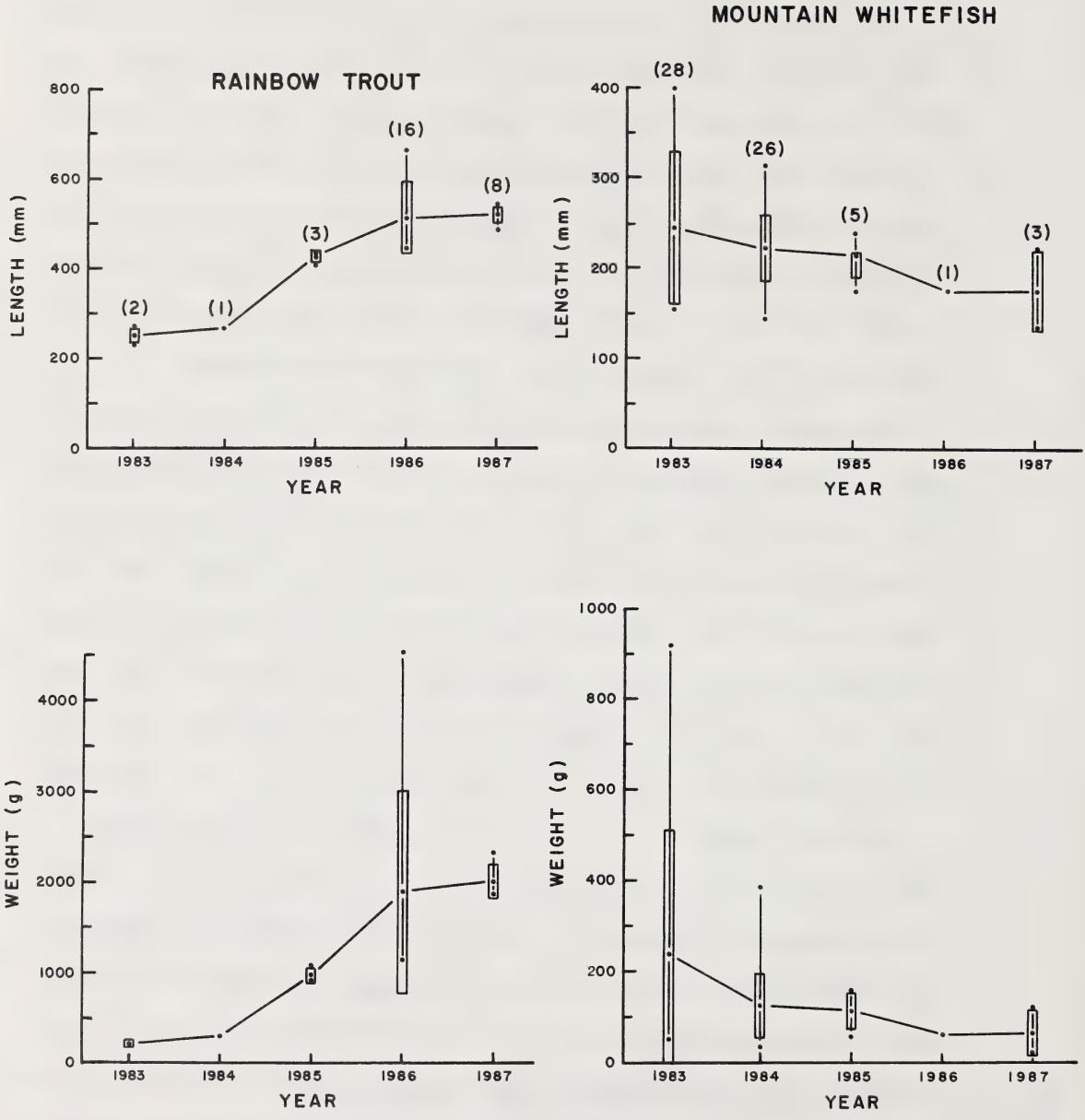

Figure 8. Fork length and wet weight (average, range, standard deviation) of rainbow trout and mountain whitefish from Gleniffer Lake. Numbers in parenthesis are sample size.

Table 10. Catch per unit effort (1983 to 1987) based on annual fall gill net collections.

	Catch Per Unit Effort (Number of Fish per 1000 m net per hour)				
Species	1983	1984	1985	1986	1987
Longnose Sucker	0.90	2.34	0.61	0.74	0.68
White Sucker	0.20	0.88	0.27	0.32	0.45
Northern Pike	0.20	0.55	0.17	0.11	0.14
Burbot	0.03	0.27	0.05	0.08	0.03
Mountain Whitefish	0.30	0.61	0.02	0.01	0.02
Rainbow Trout	0.02	0.03	0.01	0.11	0.04
Brown Trout	0.02	0.03	-	-	-
Brook Trout	-	-	0.01	-	-
Dolly Varden	0.01	-	-	-	-
Trout-Perch	-	-	-	0.01	0.01
Spottail Shiner	-	-	-	0.01	0.04
Spoonhead Sculpin	-	-	0.01	-	-
Chub	-	0.03	-	-	-
TOTAL	1.68	4.74	1.15	1.39	1.41
Number of Hours Fished	94	126	205	211	217
Length of Nets Used	1000	400	1050	800	850

The average length and weight of longnose sucker and white sucker did not change appreciably throughout the study (Figure 9). Although the same applies to burbot (Figure 10), the average size of northern pike increased during the first three years of the study (Figure 10). Relatively small specimens of all four of these species were caught throughout the study, indicating successful reproduction.

4.4 Creel Census

The most commonly captured species in all three years of the creel census was rainbow trout, accounting for 51-57% of the catch from Gleniffer Lake (Table 11). The second most common species was northern pike followed by brown trout. The CUE for anglers in Gleniffer Lake was extremely low (Table 11). The anglers reported that 11-45 hours of fishing were required to catch one fish.

The rainbow trout angled from Gleniffer Lake averaged 380 mm in length in 1985, increasing to 542 mm by 1987 (Table 12). The average length of northern pike on the other hand remained more or less constant throughout the study, as did the length of brown trout for 1985 and 1986 (Table 12).

Rainbow trout was the most frequently captured species in the Trout Pond and Dam Pond, accounting for 86% of the catch in 1986 and 53% in 1987 (Table 11). Mountain whitefish generally ranked second in abundance in the catches, but in 1987, a large number of suckers were caught (Table 11). Although rainbow trout were planted in the Trout Pond during 1985, no trout were found during the creel census

Table 11. Creel census summary.

GLENIFFER LAKE

	1985		1986		1987	
Total Fish Caught						
Fish per h	0.089		0.022		0.050	
h per Fish	11.3		45.4		20.0	
Species Composition	N	%	N	%	N	%*
Rainbow trout	287	57.1	67	51.5	21	55.3
Brown trout	83	16.5	22	16.9	2	5.3
Northern pike	120	23.9	36	27.7	14	36.8
Mountain whitefish	8	1.6	0	0	0	0
Longnose sucker	1	0.2	3	2.3	1	2.6
Dolly Varden	0	0	0	0	0	0
Cutthroat trout	3	0.6	0	0	0	0
Burbot	0	0	2	1.5	0	0

OTHER AREAS**

	1985		1986		1987	
Total fish caught						
Fish per h	0.057		0.23		0.18	
h per Fish	17.5		4.3		5.6	
Species Composition	N	%	N	%	N	%
Rainbow trout	0	0	320	86.3	115	52.8
Brown trout	0	0	5	1.3	4	1.8
Northern pike	0	0	4	1.1	9	4.1
Mountain whitefish	14	56	20	5.4	36	16.5
Longnose sucker	1	4	0	0	38	17.4
Cutthroat trout	0	0	1	0.1	1	0.5
Walleye	10	40	17	4.6	14	6.4
Sauger	0	0	4	1.1	1	0.5

* N=number; %=% of catch
**Trout Pond, Dam Pond, diversion tunnel outflow, and service spillway.

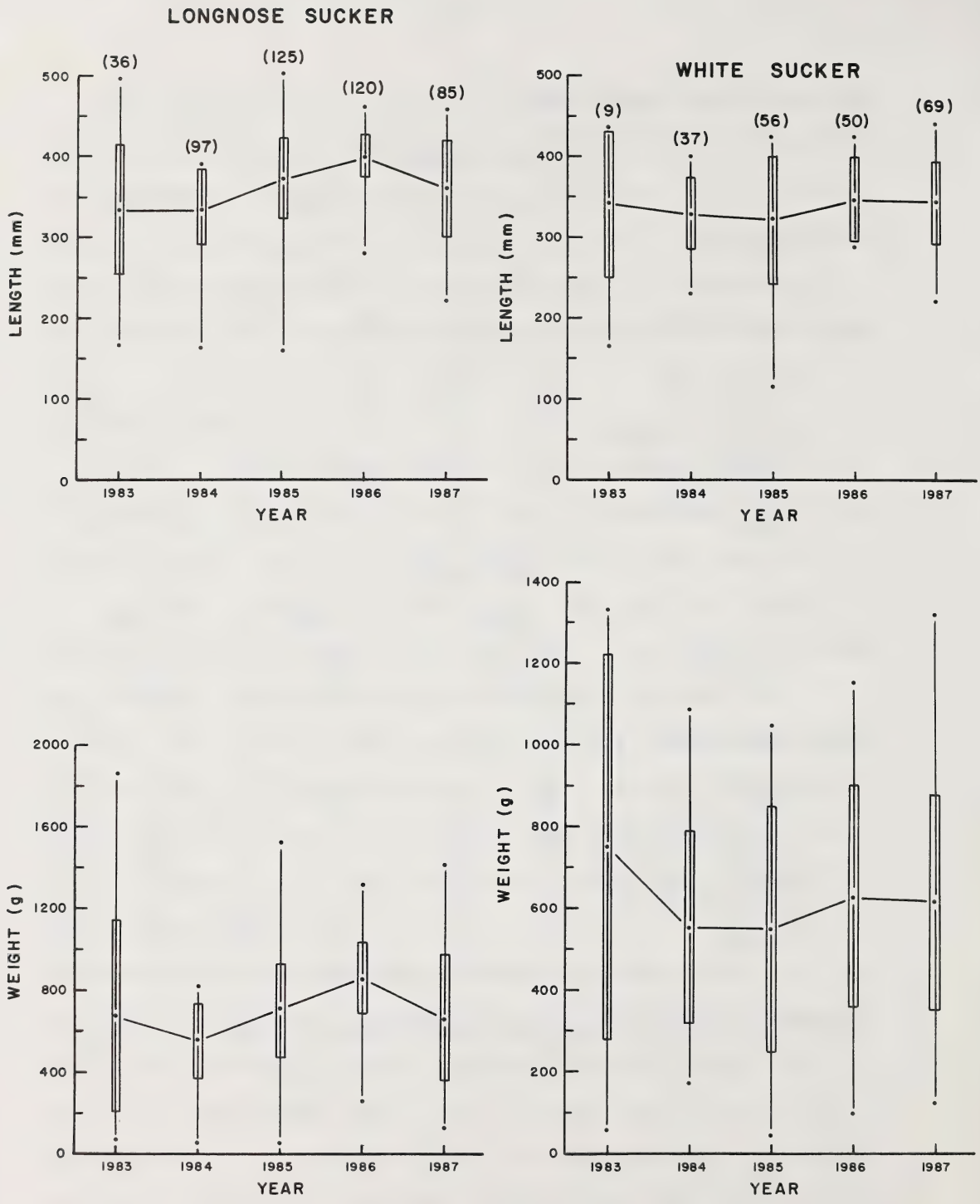

Figure 9. Fork length and wet weight (average, range, standard deviation) of longnose sucker and white sucker from Gleniffer Lake. Numbers in parenthesis are sample size.

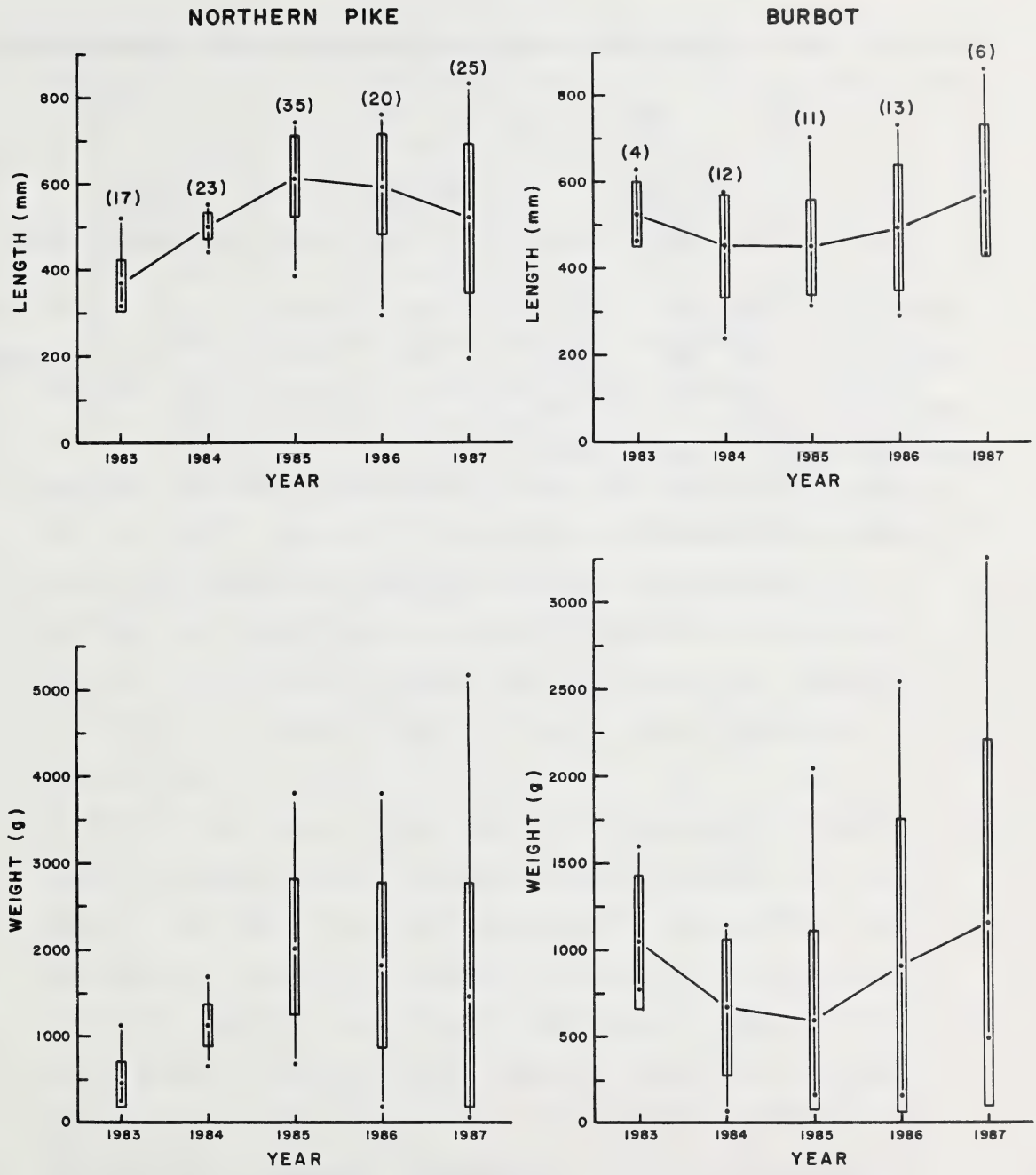

Figure 10. Fork length and wet weight (average, range, standard deviation) of northern pike and burbot from Gleniffer Lake. Numbers in parenthesis are sample size.

Table 12. Fork length of fish examined during the creel census - Gleniffer Lake.

Species	1985			1986			1987		
	N	Average Length (mm)	Range	N	Average Length (mm)	Range	N	Average Length (mm)	Range
Northern Pike	53	594	382-718	18	556	443-745	6	542	417-683
Rainbow Trout	154	380	260-566	53	435	190-602	10	542	452-658
Brown Trout	42	379	261-480	19	408	249-519	0		
Cutthroat Trout	3	398	350-435	0			0		

N = Number of fish examined

(Table 11), probably because the planted fish were too small for capture.

5. DISCUSSION

One of the key findings of this study was the extremely low CUE in both the creel census and gill net studies in the reservoir. Over the course of the creel census, anglers had to spend 11-45 h to catch just one fish. Similarly, the overall CUE for gill nets was only 1-4.7 fish per 1000 m net per h. The salmonid stocking program did not significantly improve the quality of angling in the reservoir. It is not known why rainbow trout and cutthroat trout failed to spawn in the reservoir. Furthermore, it appears that the northern pike population also failed to maintain population gains after impoundment, as discussed later.

Of all the species present during filling, mountain whitefish showed the greatest decline in abundance during the study. It is not known if this decline was due to emigration to more suitable lotic environments or inability to reproduce successfully. In either case, no juvenile whitefish were found in the reservoir throughout the entire study. A similar study on Southern Indian Lake, Manitoba, (Bodaly et al., 1984) attributed the post-impoundment collapse of the lake whitefish (Coregonus clupeaformis) to emigration from the reservoir. It has also been noted that increased sedimentation in

reservoirs reduces the rate of survival of lake whitefish eggs (Fudge and Bodaly, 1984).

Northern pike populations often expand after the impoundment of rivers (Bodaly and Lesack, 1984; Hassler, 1969, 1970; Domanevskii, 1957; Sumari and Westman, 1969; Holcik, 1968; Beckman and Elrod, 1971; Gasaway, 1970). It is widely believed that strong year classes are produced when previously unflooded vegetation is covered with water. This improves the availability of suitable spawning areas for pike and also enhances the number of forage species. Pike production then typically declines due to variable water drawdowns during spawning and increased sedimentation which reduces the viability of spawn. Based on the CUE (gill net), there was also a sizeable increase in the pike population in Gleniffer Lake after impoundment followed by a period of decline. The average size of pike similarly increased after impoundment, only to decrease during the latter stages of the study.

Relatively little is known about the response of burbot, white sucker and longnose sucker to impoundment in other parts of their range. The population of all three species appeared to expand during the early stages of impoundment, followed by a period of decline. During this period, the average size of burbot decreased from 1983 to 1985, reflecting the recruitment of juveniles into the population.

Although walleye are present in the Red Deer River, none were netted or angled from the reservoir. This means that few walleye were trapped behind the dam or the reservoir is not suited to the maintenance of walleye. In some reservoirs, such as Tobin Lake

(Saskatchewan), strong populations are maintained many years after impoundment. However, it is not known if Gleniffer Lake is suited for the maintenance of walleye. This means that a walleye stocking program should be implemented on a step-by-step basis, with regular evaluation of the success of such a program.

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APPENDICES

Appendix I - Fish species collected from Gleniffer Lake (1983 - 1987).

Common Name	Family	Scientific Name
Rainbow Trout	Salmonidae	*Salmo gairdneri*
Brown Trout		*Salmo trutta*
Dolly Varden		*Salvelinus malma*
Brook Trout		*Salvelinus fontinalis*
Mountain Whitefish		*Prosopium williamsoni*
Northern Pike	Esocidae	*Esox lucius*
Burbot	Gadidae	*Lota lota*
White Sucker	Catostomidae	*Catostomus commersoni*
Longnose Sucker		*Catostomus catostomus*
Trout-Perch	Percopsidae	*Percopsis omiscomaycus*
Spoonhead Sculpin	Cottidae	*Cottus ricei*
Fathead Minnow	Cyprinidae	*Pimephales promelas*
Spottail Shiner		*Notropis hudsonius*
Longnose Dace		*Rhinichthys cataractae*
Fathead Chub		*Platygobia gracilis*
Lake Chub		*Couesius plumbeus*

Appendix II – Example of user survey form used to record the number and location of anglers.

Date:_____ Shift: a.m.:_____
Time: start_____finish_____ p.m.:_____

Area	No. of Fishermen on Shoreline	No. of Boats	No. of Fishermen in Boats	Total No. of Fishermen	% of Total Fishermen	Sampling Time	No. of Fishermen Sampled
1							
2							
3							
4							
5							
6							
7							
TOTAL							
Trout Pond							
Dam Pond							
8							
9							
TOTAL							
GRAND TOTAL							

Appendix III - Example of creel census interview form.

Have you or your fishing party been interviewed for this creel census already today? YES__NO__
Have you gone fishing since you were last interviewed? YES__NO__

Sample No.:_____DATE:_____TIME:_____

Location:_____No. in Party:_____

City/Town of origin of fishermen:_____

Time started fishing:_____Time finished:_____

Fishing Method: Shore_____Boat_____
Stillfishing_____Trolling_____Casting_____
Bait-natural_____Artificial_____

Creel Summary:

Area Fished		1	2	3	4	5	6	7	Total	Trout Pond	Dam Pond	8	9	Upstr. RDR	
Hours															
	Kept														
RBT	Rel.														
	Kept														
BRT	Rel.														
	Kept														
CT	Rel.														
	Kept														
NP	Rel.														
	Kept														
RMW	Rel.														
	Kept														
W	Rel.														
	Kept														
Other	Rel.														
	Kept														
TOTAL	Rel.														

Harvest Record:

Species	Fish No.	Fork Length (mm)	Weight (g)	Aging Structures Taken	Tag No.	Comments

Comments: (Fishermen's comments, fisheries management concerns, points of interest, etc.)

_____

_____

_____

N.L.C. - B.N.C.
3 3286 09965349 1